REMARKS

Amendments to the Specification

The description in the Summary of Invention has been amended to conform the Summary to be commensurate with amended claims 1. Claim 1 has been amended pursuant to the informality objection so that the word "one" has been inserted into line 8.

Patentability Of the Claims Over The Cited References

The Examiner has rejected claims 1, 2, 4, 5, 7, 8 and 62 under 35 U.S.C. 102(e) as being anticipated by United States Patent No. 6,058,127 issued to Joannopoulos et al. The Examiner is requested to reconsider and withdraw this rejection in view of the following observations on the difference between the claims of the present invention and the disclosure of Joannopoulos et al. (Joannopoulos).

Regarding the rejection of base claims 1,2,4,5,7,8,and 62 Applicants believe that the Examiner misquotes Joannopoulos et.al. when he states that "In regards to claims 1 and 62, Joannopoulos discloses a photonic crystal having a tunable band structure...". In fact, in Joannopoulos (abstract, column 1 lines 18-26, column 3 lines 38-47, and Figure 1) there is no mention of a tunable band structure in the sense that Applicants teach. Joannopoulos describes only a tunable micro-cavity within a photonic band gap. While the terminology may appear similar, the words refer to two very distinct situations. A micro-cavity as taught in Joannopoulos is a localized defect in an otherwise periodic dielectric background. Such a micro-cavity induces a change in the photonic band structure over a narrow frequency interval surrounding the resonance

frequency of micro-cavity. For the typical micro-cavity envisioned by Joannopolous, this frequency interval is about 0.1% of the resonance frequency of the micro-cavity (see width of peak in Figure 5). When the micro-cavity is "tuned" according to Joannopoulos, the resonance frequency of the micro-cavity is typically shifted by no more than 0.5% of the original resonance frequency (see shift of peak in Figure 5). This is caused by a change in the nonlinear refractive index of the defect by an amount that is about 0.5% of the original refractive index.

The effect which Joannopoulos teaches is entirely distinct from the nature and the mechanism of tuning that is described in Applicants patent application:

(i) Tunable band structure as described in Applicants' patent application refers to the shift of the bands of electromagnetic wave propagation outside of the photonic band gap with the concomitant modification of the overall gap. It is not restricted (as in the case of Joannopolous) to the very small shift in frequency of a narrow resonance mode with the photonic band gap.

(ii) The magnitude of the tuning described by Joannopoulos (of roughly 0.1%-0.5%) would have no significant effect on the photonic band structure. The photonic band structure features typically span roughly 10% of the gap center frequency (roughly 100 times greater than the width of the micro-cavity resonance of Jaonnopolous). Hence the mechanism described by Joannopoulos is applicable to tuning a localized micro-cavity and NOT the photonic band structure in the sense that Applicants describe.

(iii) The mechanism of tuning a micro-cavity described by Joannopoulos is based on a scalar, nonlinear, non-birefringent, dielectric constant, involving the response of bound

electrons in a solid. This underlies the very small magnitude of the frequency shifts (0.1% -0.5%) attainable by Joannopoulos et. al. in the near-infrared and visible spectra. In Applicants' invention, the mechanism for tuning, by contrast, is based on a non-scalar (tensor), linear, birefringent, dielectric constant, involving the rotation and re-orientation of liquid crystal molecules, ferro-electric grains etc... This underlies the relatively large magnitude of our frequency shifts (1%-10%) of band structure features. The magnitude of the tuning described by Joannopoulos (by virtue of their requirement of a nonlinear dielectric constant) depends on the intensity of the electromagnetic wave propagating in the photonic crystal. The magnitude of the tuning that we describe in our patent application (by virtue of our use of a linear dielectric constant) does not require high intensity electromagnetic fields.

(iv) The tuning mechanism of Joannopoulos is effective ONLY in (and limited for all practical purposes to) the case of a narrow resonance (high Q factor) micro-cavity. It is ineffective for tuning the overall photonic band structure. Applicants' tuning mechanism (based on rotating or otherwise modifying the axes of optical birefringence) is effective both for tuning the overall band structure ("global tuning") AND in the case of a narrow (high Q-factor) micro-cavity (a specific embodiment of "local tuning"). Nevertheless, Applicants' mechanism for local tuning (based on a linear dielectric constant) is distinct from that taught by Joannopoulos (based on a nonlinear dielectric constant).

(v) The typical time scale of the (small) tuning of the micro-cavity resonance mode in a photonic crystal that Joannopoulos wishes to achieve is on the scale of pico-seconds (column 5 line 43). The time scale of Applicants' (relatively large) tuning of the photonic

band structure is on the scale of 100 nanoseconds (in the case of ferro-electric grains) to milliseconds (in the case of liquid crystals).

The Examiner has rejected claims 3, 6, 9 and 10 under 35 U.S.C. 103(e) as being unpatentable over Joannopoulos as applied to claim 2, and further in view of Zakhidov et al. (U.S. Patent No. 6,261,469 B1). In view of the above discussion regarding Joannopoulos the Examiner is requested to reconsider and withdraw this rejection. Points (i) – (v) discussed above clearly distinguish Applicants' invention from that of Joannopoulos. Applicants assert that the combination of Joannopoulos and Zakhidov will still not give the subject matter of these claims and therefore request withdrawal of this rejection.

In view of the foregoing it is respectfully submitted the present application recites subject matter which is patentably distinguishable over the cited references and allowance of the application is courteously solicited.

Should the Examiner have any questions regarding the amendments made herein, it would be appreciated if the Examiner would contact the undersigned attorney of record at the telephone number shown below for purposes of expediting the prosecution of this application. **Please send all correspondence to the address below.**

Respectfully submitted,

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